U.S.
SD
11
.A1
A42
no. 538

PSW FOREST AND RANGE
EXPERIMENT STATION
JAN 17 1966
STATION LIBRARY COPY

105
Translations
FS-538

ECOLOGICAL OBSERVATION OF WOODPECKERS INJURING TELEPHONE POLES AND SOME MEANS OF PREVENTING DAMAGE

By: Shigeru Nakajima and Kaoru Shimizu

Translated from Japanese
By: Joint Publications Research Service
Department of Commerce

U. S. Department of Agriculture
Forest Service
Washington, D. C.
November - 1965

S45.H

ECOLOGICAL OBSERVATION OF WOODPECKERS INJURING TELEPHONE POLES AND SOME MEANS OF PREVENTING DAMAGE

Shigeru Nakajima and
Kaoru Shimizu, Applied
Entomology Laboratory,
Miyazaki University.

Miyazaki University,
Department of Agriculture
Research Bulletin, Vol. 2,
Nos. 1-2, 12-21 (1956).

Introduction

The damage inflicted on telephone and power transmission poles in the mountainous areas of Japan, the resulting shortening of the life of these poles and the interruption of both telephone communication and power transmission have now become a serious problem which can no longer be left neglected. In view of these circumstances, the authors commenced a study of the ecology of woodpeckers with the intent of obtaining knowledge on the ecology of woodpecker damage to wooden poles which could eventually lead to the development of measures for the prevention of such damage, the study starting in 1952 and consuming some three years of effort. Ordinarily woodpeckers have a natural instinct for boring holes in tree trunks and dead wood for the purposes of foraging for food and nesting, but when one closely observes the action of woodpeckers boring holes into and damaging wooden poles, there is some reason to believe that this action is partly motivated by the need to abrade and to prevent overgrowth of the bill. From these standpoints, various measures for preventing woodpecker damage were instituted in the areas in which the greatest damage to telephone and power transmission poles had been experienced, and the results were observed continuously for three years. Although some of the results will not be conclusive until some time in the future, it was considered opportune to consolidate the results obtained to date in this paper.

The authors would like to thank the Japan Telegraph and Telephone Corporation and the Kyushu Electric Communication Bureau for their overall assistance in the conduction of this investigation, also the Shinetsu Electric Communication Bureau, the Miyazaki Electric Communication Depart-

ment, and the Oita Electric Communication Department for their cooperation, and also Mr. Y. Nakajima for his constant encouragement.

I. Investigation of Woodpecker Ecology

1. Range

Woodpeckers in Japan comprise some 19 species belonging to 4 genera and 1 sub-genus. In the areas investigated by the authors, there were 7 species, their range being as follows.

Table 1. Species of Woodpeckers in Miyazaki, Oita, Nagano, and Niigata Prefectures.

Area	Location	Species identified*	Range of species*
Miyazaki	Kakuto	Kagoshima-aogera, Namie-oo-akagera, Kyushu-kogera.	Kagoshima-aogera Namie-oo-akagera Kyushu-kogera
	Aoi-dake	Kagoshima-aogera, Kyushu-kogera.	
	Takaoka	Kagoshima-aogera, Namie-oo-akagera, Kyushu-kogera.	
	Tsubana-toge	- - - - - -	
Oita	Tsukumi	- - - - - -	Kagoshima-aogera Namie-oo-akagera Kyushu-kogera
	Saeki	- - - - - -	
Nagano	Mure	Akagera-rui	Aogera-rui Akagera-rui Oo-akagera-rui Kogera-rui
	Ichifuri	Aogera-rui, Akagera-rui.	
Niigata	Aoki-mura	Aogera-rui, Akagera-rui, Kogera-rui	
	Karuizawa	Aogera-rui, Akagera-rui, Kogera-rui.	

* Aogera-rui=Picus awokera awokera (Japanese green woodpecker).

Akagera-rui=Dryobates major hondoensis (Hondo great-spotted woodpecker).

Oo-akagera-rui=Dryobates leucotos stejnegeri (Kuroda) (Japanese white-backed woodpecker).

Kogera-rui=Dryobates kizuki nippon (Kuroda) (Hondo pigmy woodpecker).

Kagoshima-aogera=Picus awokera horii (Takatsukasa).

Namie-oo-akagera=Dryobates leucotos namiyei (Stejneger).

Kyushu-kogera=Dryobates kizuki kizuki (Teminck).

2. Habits

Woodpeckers inhabit natural mixed forests, particularly along the ridges of mountains. Although the Hondo great-spotted woodpecker and the Hondo pigmy woodpecker are both resident birds, there is some local movement with the seasons. In fall and winter, they move to the lower mountains, are often seen in the vicinity of hamlets in the mountain valleys, and rarely on trees in city gardens. With spring, all woodpeckers retreat to the high and remote mountainous areas. In their local habitat, one can distinguish between two sites preferred by the birds, namely, (a) feeding ground: trees with a rough-textured bark such as oak, elm, pine, and lauraceae, depending on the peculiar habits of the species, and areas with much deadwood; (b) nesting places: areas with old trees, dead trees, trees being preferred including Castanopsis, Broussonetia papyrifera (L) Vent., Pinus, and Prunus Linn.

3. Ecology

Breeding

Nests are bottle-shaped cavities bored out of the trunk of trees, the size of the cavities depending on the size of the bird. Woodpecker nests are characterized by the lack of any bottom lining, but sometimes these nests are secondarily used by the Japanese great-tit, and the Hondo nathatch, and others, in which case the nests are lined by these other birds. With respect to the reproductive organs, a change is noticed in the ovaries from around the end of January, there is further development of the ovaries by the end of February (25 birds collected in February 1955 of the species Picus awokera horii (Takatsukasa) and Dryobates kizuki kizuki (Teminck)) with the ovipositor greatly enlarged, and the first and second ova in the ovary fairly well developed. From these observations, it can probably be assumed that the woodpecker is already in breeding in February.

Food

According to past studies, the food of woodpeckers consists mainly of animal life, including some 79 species in 11 orders and 5 classes (Aves, Insecta, Arachnoidea, Gastropoda, and Miriapoda), while plant life food covers a range of only 22 species in 16 families.

(a) Animal food:

The cycle of food habits during the year consists of mainly animal food from spring to summer, particular insects of families such as Sphecoidea, Harpalidea (Coleoptera), Cerambycidae, Curculionidae, Pentatomidea, larvae of the order Lepidoptera, insects of the families Muscidae, Formiculidae (Dermaptera) and others. It should be noted that when these insects are eaten by the woodpeckers, the insect tissue matter other than chitin matter has been decomposed beyond the point of recognition in the gizzard, while the chitin tissue still retains its original semblence after 48 hours. Woodpeckers differ in their eating habits as well as in the type of food eaten. For instance, there are those such as the Japanese green woodpeckers which eat insects such as Forficulidae (Dermaptera) and Harpalidae (Coleoptera), which crawl on the ground, while there are other woodpeckers such as the Hondo great-spotted woodpeckers which eat insects such as Sphecoidea, Arachnoidea, Cerambycidae, and Pentatomidae (although the Arachnoidea is not an insect), which are found on trees. In summer however, there is no such differentiation in food habit sofar as ants (Hymenoptera) are concerned, in fact, the Japanese green woodpecker has been observed to forage intensively for and to consume a great quantity of ants on the ground. When breeding the Picus awokera horii (Takatsukasa), it was given pieces of fresh marlin meat, which it ate and lived for 29 hours.

(b) Plant food:

Plant food consists of the fruit, nut, and seed of plants but not the leaf. With woodpeckers collected by the authors, in the gizzard of one Picus awokera horii were ten seeds of one kind. Generally, the Japanese green woodpecker eats little plant food, there being only thirteen varieties of plant food identified as being eaten by this specie. The Dryobates leucotos stejnegeri (Kuroda) was found with only one kind of plant food. The Japanese Hondo great-spotted woodpecker and the Hondo pigmy woodpecker were found together to consume some nine varieties of plant food, with the pigmy woodpecker having a slightly larger appetite for plant food than the great-spotted woodpecker. The Hondo pigmy woodpecker apparently eats seeds of trees of the Rhus Linn (Sumac) family such as Rhus succedanea, Rhus verniciflua stokes (Varnish tree), Rhus trichocarpa, Rhus ambigua Lav., and Rhus chinensis Mill. Also the Dryobates kizuki kizuki (Teminck), young bird (two specimens) was found to eat rice straw, the latter being found plugging the ductwork from the proventriculus to the gizzard. There were also examples

of wood shavings and string (plant fiber) being found in the gizzard of the Hondo great-spotted woodpecker.

Breeding

With respect to the breeding of woodpeckers, there is very little information on the subject other than the records of Godo Nakanishi. The breeding of woodpeckers is, to say the least, difficult, not only because of the difficulty of live capture and the difficulty of getting the bird to eat prepared food, but in general because of the lack of knowledge concerning the basic outdoor ecology of the bird which could be used to establish some method of breeding. Here we shall describe a few feeding conditions experienced by the authors in breeding woodpeckers: (a) Outside of the nesting period, the birds adapted easily, and they were voluntarily eating fish meat two days after capture; (b) When an apple was offered, the woodpecker stuck out his tongue, extended it further so as to come in contact with the entire surface of the fruit, and then proceeded to eat; (c) With citrus fruits, the skin of the fruit was first broken with the beak, after which, with repeated elongation and withdrawal of the tongue, the meat of the fruit was sucked into the mouth and swallowed; (d) Drinking of water was performed in a manner similar to that done by hens, that is, water contained in the beak was swallowed by means of throwing back the head; (e) Once the bird became accustomed to capture, it could be fed easily on ground feed, consisting of 5 parts of rice flour, 2 parts of soya-bean flour, 3 parts of larva grounds, and green vegetable.

II. Investigation of the Ecology of Damage

1. Damage to telephone poles

The authors have classified the woodpecker's action of boring holes in wood into three categories: (a) Boring for the sake of finding food; (b) Boring for the sake of establishing a nest; and (c) Boring for the sake of abrading the beak to prevent overgrowth. With respect to the systematic development of these actions, (a) is probably the most primitive action. This will stimulate the development of the mouth organs, and the strong impulse which also develops will lead to the morphological repairing action (c). It can be further assumed that only during the nesting season will action (c) become action (b) under the influence of sex hormones. From the standpoint of damage incurred, since during the lifetimes of telephone poles (13 to 20 years for sulfur-treated poles, 20 to 30 years for creosote-treated poles; and 5 to 8 years for non-impregnated poles) woodboring insects do not get a foothold, the damage due to action (a) is also rare. The damage due to action (b) can be considered to be small due to the fact that it is limited to the nesting period. It then follows that most of the damage to trees is due to action (c).

2. Analysis of the environment

(a) Biological investigation

The rate of damage to telephone and power line wooden poles within the area investigated was 39.3% in the case of virgin forests and 21% in the case of reforested stands. The lowest height on tree trunks at which woodpecker damage was found depended on the height of the underbrush, with most of the damage found above this height, but in the case of dead trees, damage was found extending all of the way to ground level in the Takaoka tract. The range of a single woodpecker's activity is fairly large, and it seems that it makes a periodic round of dead trees and telephone poles.

(b) Topographical survey

Most of the damage was found on the middle and upper slopes, more of the damage occuring on the middle slopes, for instance in the case of Kakuto in Miyazaki Prefecture, 39.2% of 125 poles were damaged. Even in the case of level lands including cultivated lands, there was considerable damage if such land was surrounded by mountains such as in the case of Karuizawa in Nagano Prefecture.

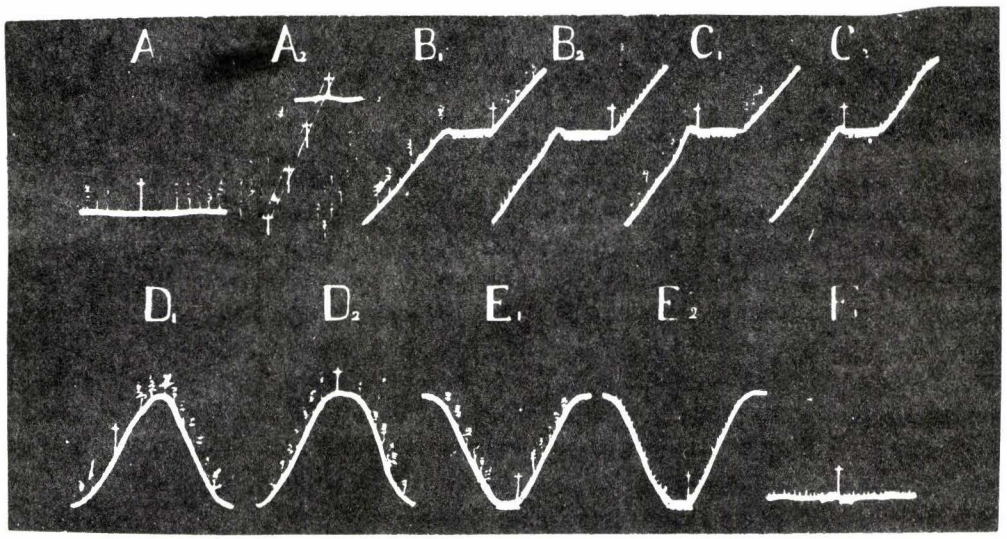
(c) Investigation of climate

In Karuizawa with its cold climate, there was damage due to the Hondo great-spotted woodpecker, while in the warm climate of southern Kyushu, there was damage due to Dryobates leucotos namiyei (Stejneger). The Hondo great-spotted woodpecker is known to wander far during the autumn and winter such that the area of damage due to this specie is also enlarged. Also generally, there is heavy damage in spring because of the nesting season. The Hondo great-spotted woodpecker, the Dryobates pencotos stejnegeri (Kuroda), and the Hondo pigmy woodpecker all make new nests every year, often remaking several nests in the effort, and in the Niigata-Nagano areas, there were 5 out of 131 damaged poles in which the nests had been completed.

(d) Environmental factors

In attempting to analyze environmental factors in areas of heavy damage to poles, in addition to biological, topographical, climatical, and other considerations, some independent approaches were also attempted, but generally speaking, clear separation of the factors was not possible due to the intimate relations existing between the various factors. Therefore, based on the results of past research, the authors classified the environment with tree damage tentatively into eleven environmental types as shown in Figure 1.

Figure 1. Types of environment in which woodpecker tree damage occurred.



A_1 type of environment: Level forested area with power line traversing area. Damaged poles are in a semi-exposed type of situation with respect to the forest stand.

A_2 type of environment: Similar to the A_1 type of environment, but located on a slope with the power or telephone line running up the slope. Poles are in semi-exposed type of situation.

B_1 type of environment: Similar to the former except that a road runs parallel to the slope with the power line paralleling the road on its upper-slope side. The poles are covered by the forest in a semi-exposed type of situation.

B_2 type of environment: Similar to B_1, except that there are no trees, and the poles are completely exposed.

C_1 type of environment: Similar to B_1, except that the line of poles is located on the down-slope side of the road. The poles are in a semi-exposed type of situation.

C_2 type of environment: Similar to C_1, except that there are no trees. Poles are completely exposed.

D_1 type of environment: Similar to B_1 or C_1, except that there is no road, and the poles are completely exposed.

D_2 type of environment: Case where the line of poles follows the ridge line. The poles are actually covered by the forest, although topo-

graphically it may seem like an exposed situation, and the poles are more semi-exposed than in cases B_1 or C_1.

E_1 type of environment: Where the line of poles follows a trench in the ridge or a road in a valley. The poles are in a semi-exposed type of situation due to the overhanging of trees from both sides.

E_2 type of environment: Same as E_1 except that the land is nude.

F_1 type of environment: Completely exposed type of situation with grassy or bush vegetation only.

From actual field investigations, the degree of damage to poles depending on the type of environment involved was as follows:

Order of degree of damage	1	2	3	4	5	6	7	8	9	10	11
Type of environment	D_1	C_1	A_2	F_1	D_2	A_1	E_1	C_2	E_2	B_2	B_1
No. of sites	32	20	16	11	10	9	8	4	2	2	1

The above results show that despite the detailed differences between the various types of environments, there are some common factors related to the degree of damage experienced. It is noted for instance that (1), from the large environmental standpoint, the power line exists in the forest land in a semi-exposed situation; and (2) from a local environmental standpoint, the poles exist in an exposed condition.

3. Analysis of damaged poles

This analysis was based on damaged poles located between Tano and Aoi-dake (Miyazaki Prefecture, Miyazaki-gun, Tano-cho and same prefecture, Kitamorogata-gun, Aoi-dake).

(a) Distribution of woodpecker-made holes on poles as a function of direction: When one studies the holes made in a telephone pole by woodpeckers, it is immediately noticed, as can be seen from Figure 2, that the holes tend to be concentrated on the surface of the poles in some particular direction. It is found that this direction is not some particular azimuth angle or angles, but that it is apparently determined by a combination of conditions involving the pole and its environment. It can therefore be assumed from these results that the next cycle of damage to these poles will occur in these preferred directions.

(b) Azimuth angle of most frequent damage: With respect to the poles located between Tano and Aoi-dake, the distribution in azimuth

angle of some 55 holes was as shown in Figure 3. It is seen that the holes occurred most frequently on the south to west sides, and least on the north side.

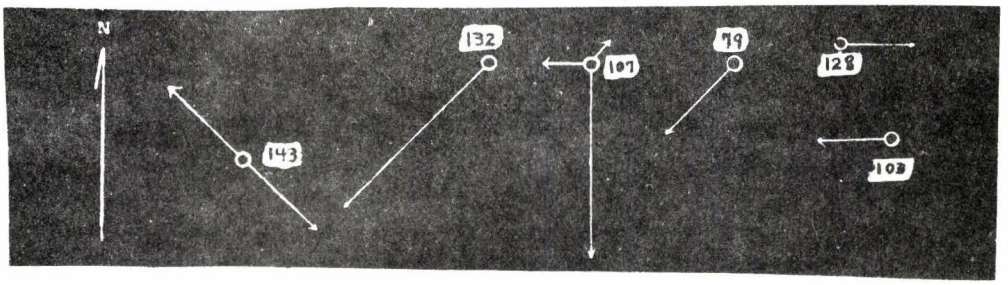


Figure 2. Distribution of directions of most frequent damage. |___| is unit for a single hole.

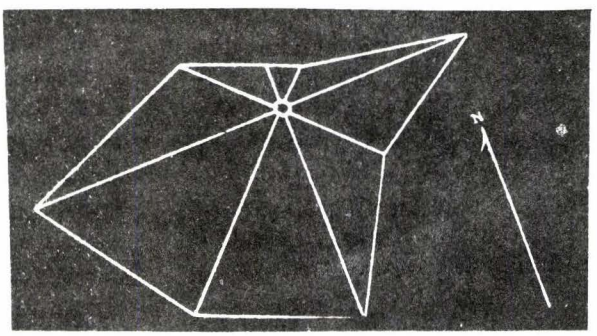


Figure 3. Distribution of holes in azimuth angle.

This means that there was some condition of the pole or of the environment which caused preferential damage to occur on the south to west side of the poles, and also that this direction was not related to the azimuth direction.

(c) Vertical location of the holes: The results showed that holes were found most frequently at 3 to 4.5 meters and also again at 5 to 6.5 meters height above ground, with a dip in the distribution between these two peaks. It was found that the height at which the holes most frequently occurred depended on the length of the pole, for instance, the most frequent height was 3 to 4.5 meters for poles of 7 to 8 meters length, and 5 to 6.5 meters for those of 9 to 11 meters length. It was also found that poles of 7 and 11 meters lengths tended to be more damaged than poles of other lengths. On the average, it can be said that woodpeckers most frequently make holes at an average height of 4.7 meters with a mean deviation of 1.18 meters. At the same time, there is a positive correlation between the height of the holes and the length of the poles. There was no correlation ($r = +0.13$) between the

height of the holes above ground and the vertical size of the holes, but there was some correlation (r=+0.36) between the frequency of occurrence of the holes and the depths of the holes.

(d) Frequency of distribution of holes on a pole: As it can be seen from the distribution in Figure 4, there is considerable scattering of the values of h, the height of the holes above ground, but if we take the ratio of h to T, the total length of the pole, then we find this ratio has a very symmetrical distribution curve such as shown in Figure 5, the distribution being almost normal with a standard deviation of 8.64 and centered at roughly 53.3%. This means that the woodpeckers do not bore holes in poles at some given height above ground, but that the determination is made relative with respect to the total length of the pole.

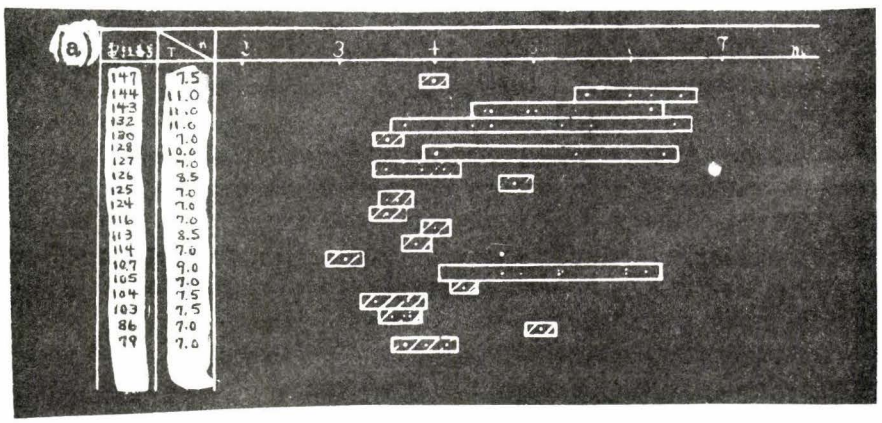


Figure 4. Distribution of heights of holes.
(a) pole number.

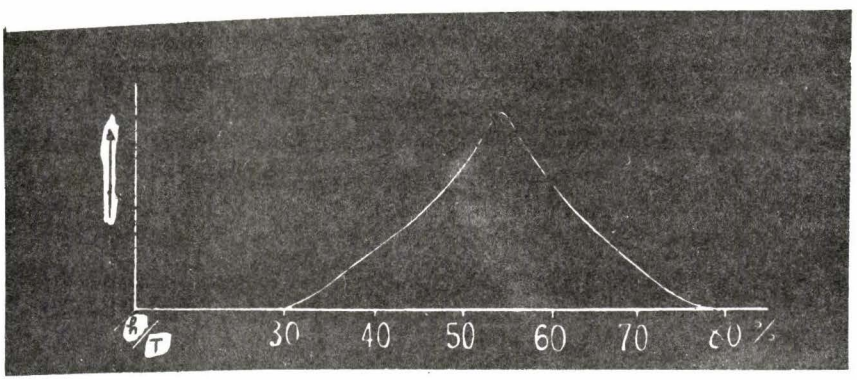


Figure 5. Distribution of h/T.

(e) Estimation of hole location: Since it was seen from Figure 5 that the relative position of holes made by woodpeckers formed nearly a normal distribution, the frequency values calculated on this basis for various locations relative to the point of maximum frequency are given in Table 2.

Table 2. Estimation of hole location. (For Aoi-dake poles.)

Deviation from mean value	End values (S_1 – S_2)	Width	Percentage to total
53.3± 1.1	52.2– 54.4	2.2	10
53.3± 2.2	51.1– 55.5	4.4	20
53.3± 3.2	50.0– 56.6	6.6	30
53.3± 4.5	48.8– 57.8	9.0	40
53.3± 5.9	47.4– 59.2	11.8	50
53.3± 7.3	46.0– 60.6	14.6	60
53.3± 9.4	43.9– 62.7	18.8	70
53.3±11.1	42.1– 64.3	22.2	80
53.3±14.3	38.7– 67.3	28.6	90
53.3±15.7	37.4– 69.0	31.4	95
53.3±28.5	24.8– 81.8	57.0	99.9
53.3±32.1	21.3– 85.4	64.1	99.99

For instance the range of h/T from 31.0% to 75.6% contains 99% of all of the holes to be expected on the pole, and therefore in terms of actual lengths (meters), the location of maximum expected damage to poles from woodpeckers can be calculated according to the following formulae for each pole.

b_1 = Minimum height of damage above ground (meters)
$= s_1 \times T/100$

b_2 = Maximum height of damage above ground (meters)
$= s_2 \times T/100$

T = Total length of pole (meters) (including part underground)

$B = (S_2-S_1)xT$ = Range of damage (meters)

(f) Shape of holes: If l is the vertical length (cm), t the horizontal width (cm), and d the depth of the hole (cm), then there are positive correlations between the pairs of quantities (l, t), (l, d), and (t, d). With respect to the correlation between l and t, the correlation factor is largest with r = +0.85, and standard deviation of 2.64 for l = 1.82t-0.31 or a standard deviation of 1.24 for t = 0.40 l-1.43. For (l, d), r = +0.38, and for (t, d), r = +0.50, which show less correlation than for the first case. With respect to the relation of the depth of the hole to the other two dimensions, for instance in the case of (l, d), where the correlation factor is relatively small, it can be said that there is considerable latitude of vertical movement in boring the hole. This can be reasonably explained on the grounds of the pecking motion of the woodpecker and the direction of the grain of the wood.

III. Measures for Prevention of Damage

1. Preventive measures used in the past

Measures which have been used in the past have mainly been physical measures of low effectiveness and of short effective duration, including such techniques as cedar leaf wrapping, clam shell suspension, or bamboo wrapping. Measures for preventing the spread of damage included methods such as the attachment of galvanized sheeting, packing with mortar, filling with clay, or packing with stone, but most of these methods were more or less in the nature of emergency methods with no assurance of their effectiveness in the long run.

2. Testing of preventive measures

(a) Wrapping with duraluminum sheeting:

Since woodpeckers must move up and down the trunk of a tree or a pole and remain attached to the surface, the wrapping of a strip of duraluminum in a spiral around the trunk should hinder such woodpecker movements. By using a ribbon of at least 5 cm width, this would prevent the woodpecker from stopping, since the toe span of the largest species is known to be about 4.5 cm. With these considerations in mind, 5 cm wide and 2 m long strips of duraluminum were spiral-wrapped at 10 cm intervals on the telephone poles and secured with nails. The advantages of this method are ease of installation, low cost (about 300 yen per pole), and no discoloring or water retention which might cause wood rot over the years [1].

(b) Reflection method:

This is a method of using a silvery reflecting paint as a scare. The paint used consisted of silver or aluminum powder (125 g) in a viscous bronze paint (500 g), well mixed, and the paint was applied over the entire area of the pole expected to receive woodpecker damage. The paint when dry had a distinctive luster which was quite reflective in sunlight. Advantages of the method were larger coverage than ordinary paint, ease of application, and rapid drying. Even with creosote-treated or new poles, the painted surface showed little sign of discoloration with time.

(c) Paint method: This method might be called the opposite of protective coloring. Although the paint does not scare the birds, because of the strongly contrasting color, woodpeckers might be less inclined to dwell on white surfaces where they might be exposed to the eyes of predators. Ordinary undercoating white paint was used for this purpose, and for effectiveness, a large as possible an area was painted, meaning, however, the area roughly two meters below the lowest sidearms on the poles. On creosote-treated and new poles, there were some indications of discoloration with time.

(d) Chemical methods:

(1) Arsenite mixed paints: It was felt that in the methods employing paints, the effectiveness could be enhanced by the addition of a poison to the paint, and tests were therefore carried out along this line. The paint used was undercoating white paint and arsenious acid in the ratio 10:1, the method of application being the same as in the case of paint alone. The purpose of this method was to discourage rather than to poison, since it would seem that since the boring action was carried on mainly with the beak, there would actually be little possibility of poison being swallowed by the bird. Some discoloring was noticed on poles which were creosote-treated or were new.

(2) Red lead mixed paint: Instead of the arsenious acid, red lead was substituted in this case. The intension was to discourage, the same as before. The ingredients were mixed in the same ratio as previously, but in this case, the resulting paint was somewhat more viscous and it was colored orange. Application was the same as before, and some discoloring was also noticed in the case of creosote-treated and new poles.

(3) Creosote-arsenious acid mixture: The mixture was prepared with the ingredients in the ratio of 10:1, with application to poles which were not creosote-treated previously. The purpose of this mixture was to function as a poison, but it was found that the arsenious acid was insoluble in the creosote and as a result, it tended to stay on the surface as a residue upon application without penetrating into the wood.

3. Test sites and results of tests

(a) Tests with telephone poles: The location of the test sites was Miyazaki Prefecture, Nishimorokata-gun, Kakutoson Kawakita, the poles supporting a three-pair line between Kobayashi and Hitoyoshi. The geography of the land can be described as the western slope of Mt. Kunimi, elevations in the range 540 to 720 meters above sea-level. The trees were mostly of indigenous types, although there were some stands of virgin pine, and planted hinoki and cedar. This line was first installed in February 1900 with severe damage from woodpeckers annually. In February 1952, 63 out of 103 poles were replaced because of serious damage, but within a year, three of the replaced poles had already suffered severe damage, and this area is known as the worst with respect to woodpecker damage in the Miyazaki Prefectural area. Due to these circumstances, the site was chosen for our tests, the tests measures being instituted during the period 16th to 18th of September 1952 according to the plan shown in Table 3.

Table 3. Preventive measures test.

Plot	Material	New poles	Old poles
Control (S)		143	60.126
Duraluminum (J)	Duraluminum sheet	151	57.128
Paint (P)	Paint primer	149	58.124
Reflector (GB)	Silver paint	102.140	69.142
Chemical (PA)	Primer white+arsenious acid	146	68.130
Chemical (PE)	Primer white+red lead	145	59.132
Chemical (KA)	Creosote+arsenious acid	141	70.148

After the test measures were performed and the test plots were kept under observation, one of the things which was noticed was the discoloration of the primer whitewash. This was most noticeable with the Paint plot (P), and the Chemical plots (PA, PE). There was no discoloration with the old poles, with the exception of the creosote-treated poles, but with the new poles, there was considerable discoloration and with some of the poles in the Paint plot, the primer had turned into a blackish-green color.

(b) Results of tests: Since woodpeckers were known to be particularly active in this test area, observation of the poles in the area was continued even after the tests, the resulting continued damage which was observed being shown in Table 4.

Table 4. Course of damage to telephone poles by woodpeckers.

Year	Month	No. of poles damaged		No. of holes observed in damaged poles	
		Monthly	Cumulative	Monthly	Cumulative
1953	Apr-Mar	1	1	1	1
	Jun	4	5	5	6
	Jul	8	13	11	17
	Aug	3	16	9	26
	Sep	17	33	33	59
	Oct	18	51	27	86
	Nov	--	51	--	86
	Dec	--	51	--	86
1954	Jan	--	51	--	86
	Feb	13	64	20	106
	Mar	--	64	--	106
	Apr	--	64	--	---
	May	6	70	8	114
	Jun	12	82	29	143
Total		82		143	

Investigation of the test was completed on June 5, 1954, and the results obtained as of this date are shown in Table 5.

Table 5. Number of telephone poles damaged after preventive measures were taken.

Plot	J	P	GB	PA	PE	KA	K
Number of damaged poles	1	0	1	0	1	1	1
Number of holes in damaged poles	2	0	2	0	1	6	3

With respect to holes found on the sections of poles which had been treated in one way or another, there was very little difference between the different measures, with the exception of the KA plot which had six holes. Damage to treated sections was slight in the other plots, with no damage in the case of the P and PA plots. In the case of the J plot, the only damage suffered was between the wrappings of the duraluminum sheet, but what was interesting in this case was the fact that the holes were quite small, and it is of interest to observe what type of motion or motions are made by the woodpecker in boring such a small hole, since the measure taken in this case was made to deliberately antagonize the woodpecker in his natural wood boring action. The fairly large degree

of damage experienced in the KA plot was to be expected in view of the fact that creosote-impregnated poles were easily attacked by woodpeckers. With respect to changes noticed in the material used or its mode of application, the most noticeable was the discoloration in plots where white paint was used as a main ingredient. There were varying degrees of discoloration depending on the type of pole, such as creosote-treated or copper sulfate-treated pole, and the age of the pole, but the greatest discoloration was observed in the case of the new creosoted-treated and the new copper sulfate poles. The discoloration was from white or orange to brown or dark green. In the case of the other plots, not much change was observed, even the duraluminum retained its lustre, and there was no damage due to strong winds. The results of the damage preventive measures tests can be summarized as follows: (a) The KA plot tended to incur the most damage, with very little difference in damage noticed between the other plots; (b) There was strong discoloration in the P, PA, and PE lots, depending on the type of telephone pole; and (c) The measure inacted in the J lot seems to be more practical than those used in the other lots, from the standpoint of effectiveness of the measure as well as low maintenance.

IV. Summary

1. Seven species of woodpeckers were identified in the geographical area investigated, Kyushu, the northern part of Nagano Prefecture, and the central part of Niigata Prefecture, namely Picus awokera horii (Takatsukasa), Dryobates major hondoensis (Hondo great spotted woodpecker), Dryobates leucotos stejnegeri (Kuroda) (Japanese white-backed woodpecker), Dryobates leucotos namiye (Stejneger), Dryobates kizuki nippon (Kuroda) (Hondo pigmy woodpecker), and Dryobates kizuki kizuki (Teminck).

2. Woodpeckers favor natural forests, particularly mixed forests, some 79 varieties of animal food and some 22 varieties of plant food. From spring to summer, a large amount of animal food is eaten, with a large appetite for ants in summer.

3. The wood-pecking or boring action of woodpeckers can be classified into three types: (1) Pecking for the purpose of finding food; (b) Pecking for the purpose of nesting; and (c) Pecking or boring for the purpose of abrading the bill to prevent overgrowth.

4. Environmental factors favorable to woodpecker damage of telephone poles are for instance a virgin forest and its environs; topographically the upper and intermediate slopes of mountains and plateaus; climatewise the Hondo great-spotted woodpecker's preference for moving about and causing the most damage in fall and winter, or a similar inclination for the other species during spring and summer.

5. Considering eleven different types of environmental conditions, those with the severest woodpecker damage were found to have the following factors in common: (a) The telephone line was contained in a forest

and was semi-exposed; (b) The poles were detached from other objects (such as the surface of the ground or other trees), so that the poles were visible from a distance, and in an exposed condition.

6. Woodpecker damage tended to be concentrated in a specific area or areas of the telephone poles. In azimuth, there was some preference for south to west with very little damage noticed on the north side of the telephone poles. The height of the holes above ground was proportional to the length of the pole.

7. Most of the measures used in the past to combat woodpecker damage were physical measures and they were not very effective.

8. The authors' approach to the problem of preventing woodpecker damage consisted of physico-chemical and ecological methods such as the duraluminum sheet wrapping method, the use of reflective coating, the use of paint, and also of chemicals (arsenite-paint method, red lead-paint method, creosote-arsenite treatment method), and the effectiveness of these various methods was compared in actual tests.

9. The previously described six methods for preventing woodpecker damage to telephone poles were tested in the locality of Miyazaki Prefecture, Nishimorokata-gun, Kakutoson, and the duraluminum sheet wrapping method was found to be the most effective of the methods tested.

BIBLIOGRAPHY

1. Allen, Arthur. A. (1951): Stalking Birds with Color Camera.

2. Arthur, A. Allen and P. Paul Kellogy (1937): Recent observations on the ivory billed Woodpecker. Auk. 54.

3. Katsura, S. (1950): Chuo engei (Central Gardening), 535.

4. Kawaguchi, Sonjiro (1937): Nippon chorui seitaigaku shiryo (Material on the ecology of Japanese birds).

5. Kiyozumi, Y. (1950): Yacho (Wild Birds), 16(6).

6. Kumagaya, Saburo (1927): Tori (Birds), 5(2).

7. Kuroda, Nagamichi (1921): Descriptions of seven new forms of Japanese and Korean Picidae. Auk 38(4).

8. Katsu, Seiichi (1950): Yacho (Wild Birds), 15(5).

9. Mishima, Fuyutsugu (1950): Dobutsu-zasshi (Journal of Zoology), 59(2).

10. Momiyama, Tokutaro (1927): Toa chogaku iho (Bulletin of East Asia Birds), 1(1).

11. Nakanishi, Godo (1937): Sanrin (Mountains and Forests), 658.

12. Nakamura, Shizuo (1951): Denken geppo [abbrev.] (Monthly Report of the Electric Research Laboratory), 4(1).

13. Kashiya, Tatsuo (1932): Goryorin (Imperial Forest Reserves) 54.

14. Op. cit. (1932), 55.